Contribution of Tropical Cyclone to Rainfall in the Vietnam Coastal Region

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Introduction (1)

-Vietnam's area is: 329560km^2.

- Northern Vietnam : four seasons.

- Southern Vietnam: dry and rainy seasons.

- Vietnam is prone to natural disasters such as storms, floods and droughts.

Fig. Vietnam map
(Source: www.worldmapsinfo.com)

Introduction (cont.)

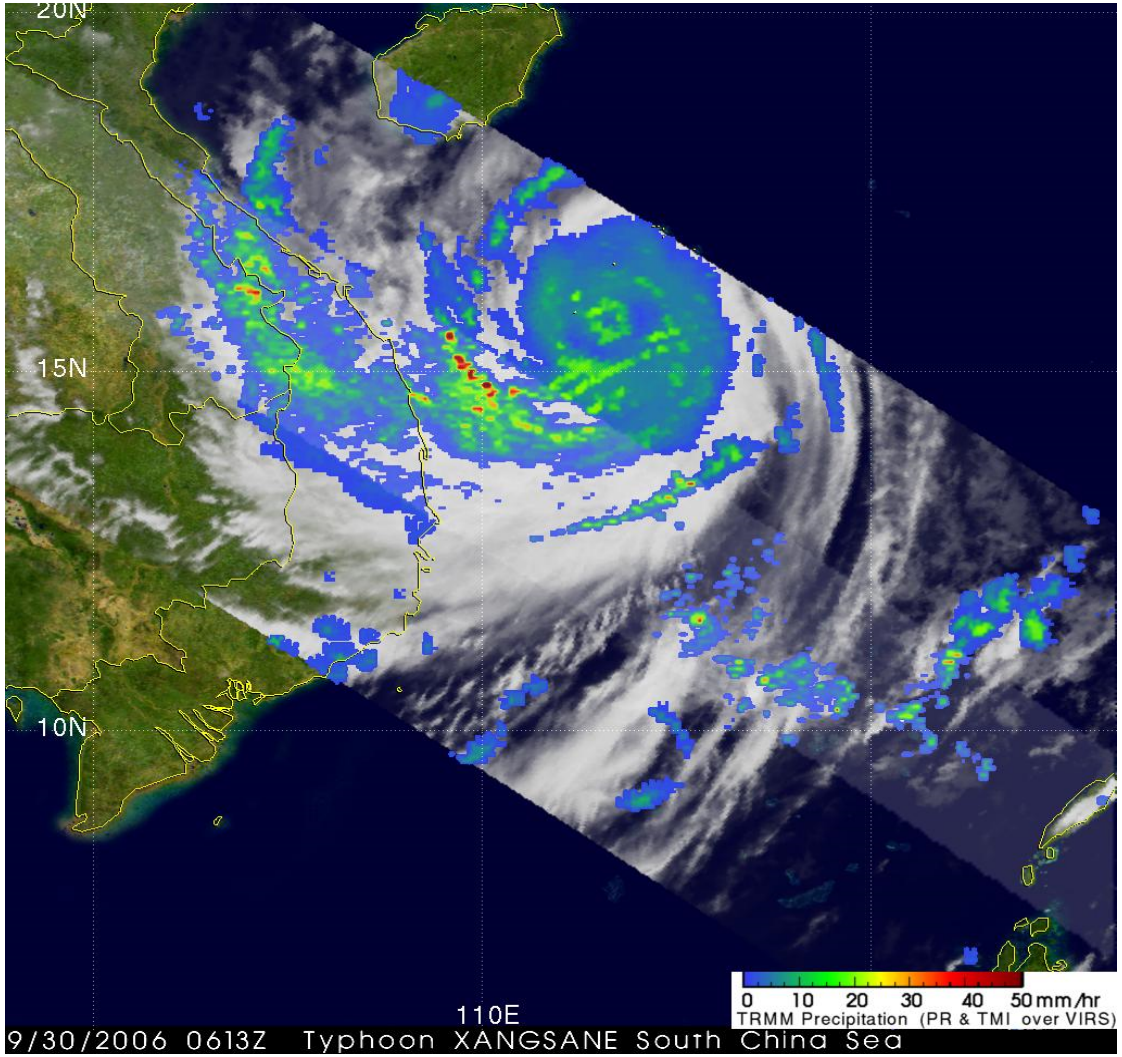
Fig. Big Inundation in Hanoi caused by very heavy rainfall (during only 2 hours)

Left : Nui Truc Street

at 19UTC 14 July 2006

Right : Nguyen Khuyen Street

at 00UTC 17 Aug 2006



Typhoon name: Xangsane

Time: 9/30/2006, 0613Z

Rainfall:

- Hue: 49.7 mm/day
- Da Nang: 22.2 mm/day
- Quang Ngai: 31.1 mm/day

Introduction (cont.)

- Vietnam is located in the typhoon center of the South China Sea, and on average, it is hit by 4-6 typhoons per year (Garcia, 2002).

But little has been known about the total rainfall contribution of TCs in Vietnam

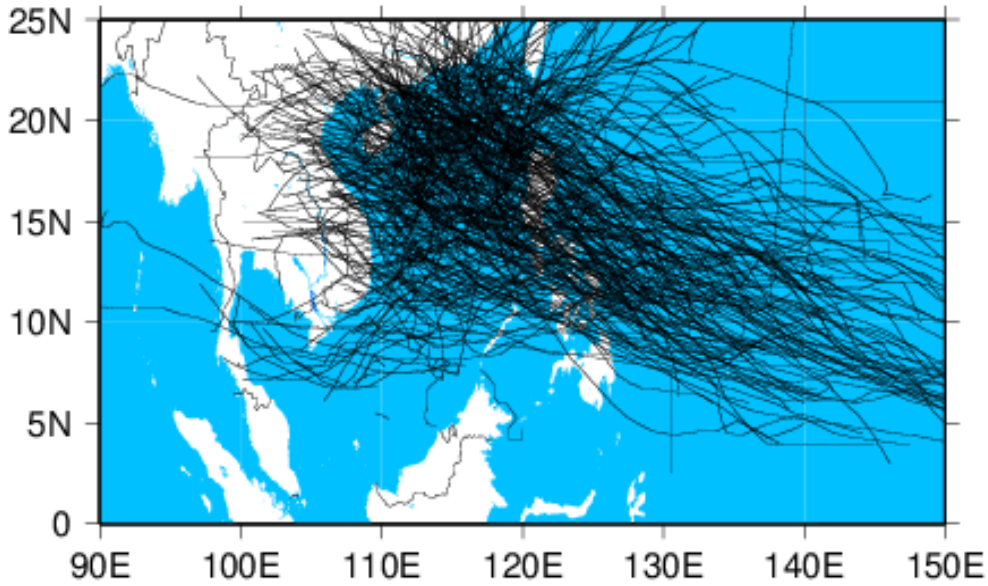


Fig. Best track all TCs in the South China Sea (1961-2008)

Introduction (cont.)

- Gleason (2006) analyzed the rainfall contribution caused by tropical cyclones in the United States.
- Kubota and Wang (2009) examined that in the Western North Pacific (WNP) region.
- Jiang et al. (2010) estimated the contribution of TCs to the global precipitation by using TRMM data.
- Hattori et al. (2010) showed the contribution of TCs to the seasonal change patterns of precipitation in the WNP based on JRA-25/JCDAS.
- Etc,.

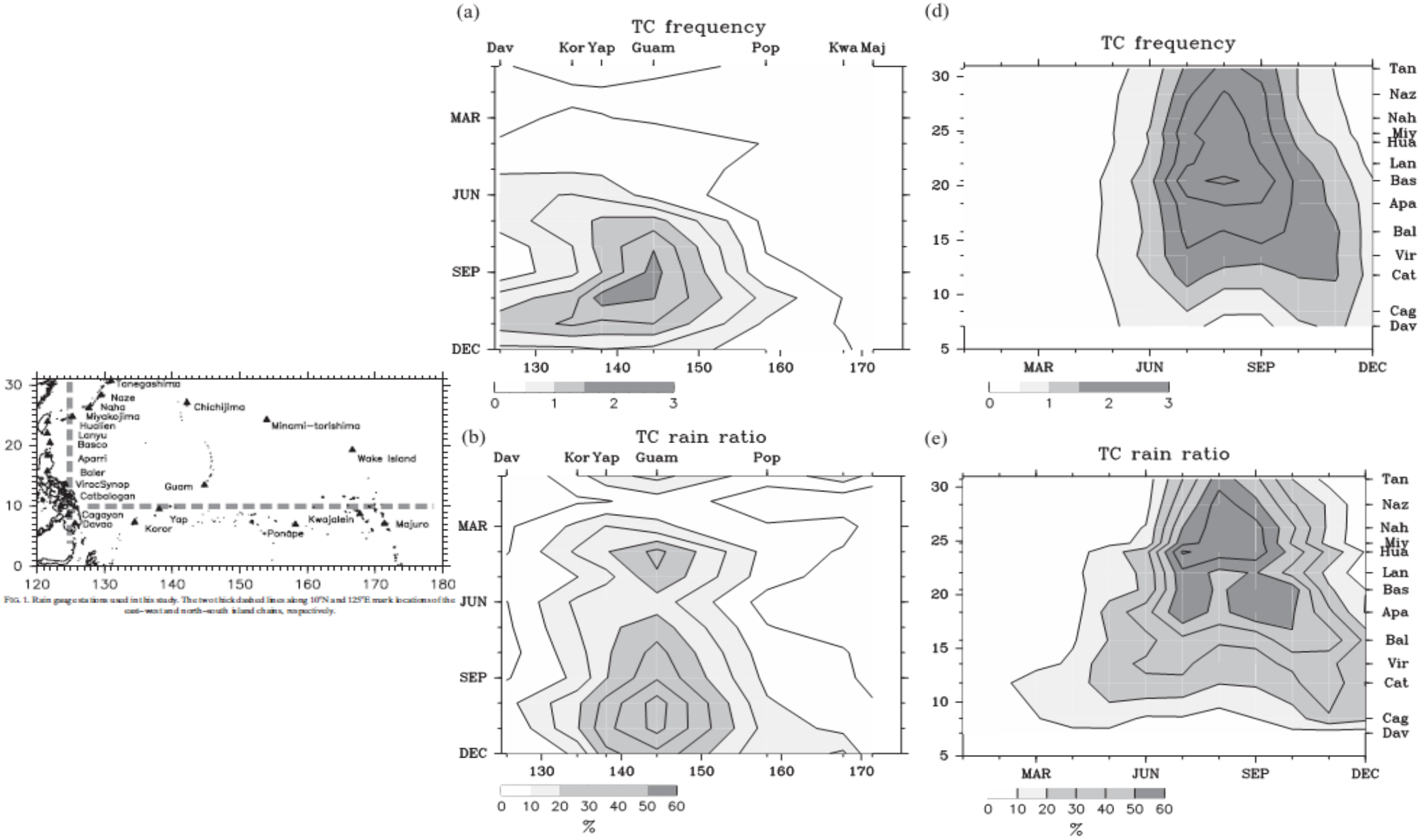


FIG. 1. Rain gauge stations used in this study. The two thick dashed lines along 10°N and 125°E mark locations of the east–west and north–south island chains, respectively.

Fig. Climatological-mean (a),(d): TC frequency, (b), (e): TC rain ratio (Kubota & Wang, 2009: JC)

Introduction (cont.)

This talk focuses on the characteristics of rainfall amount, rain ratio, and heavy rainfall days caused by TCs in the coastal region of Vietnam.

Data and Methods

Data:

- The South China Sea is defined to be the ocean body within 0°N and 25°N, and 100°E and 120°E.
- The TC best-track data are downloaded from: **http://weather.unisys.com**
- Daily rainfall of 15 weather stations in Vietnam
- The period: 1961 - 2008

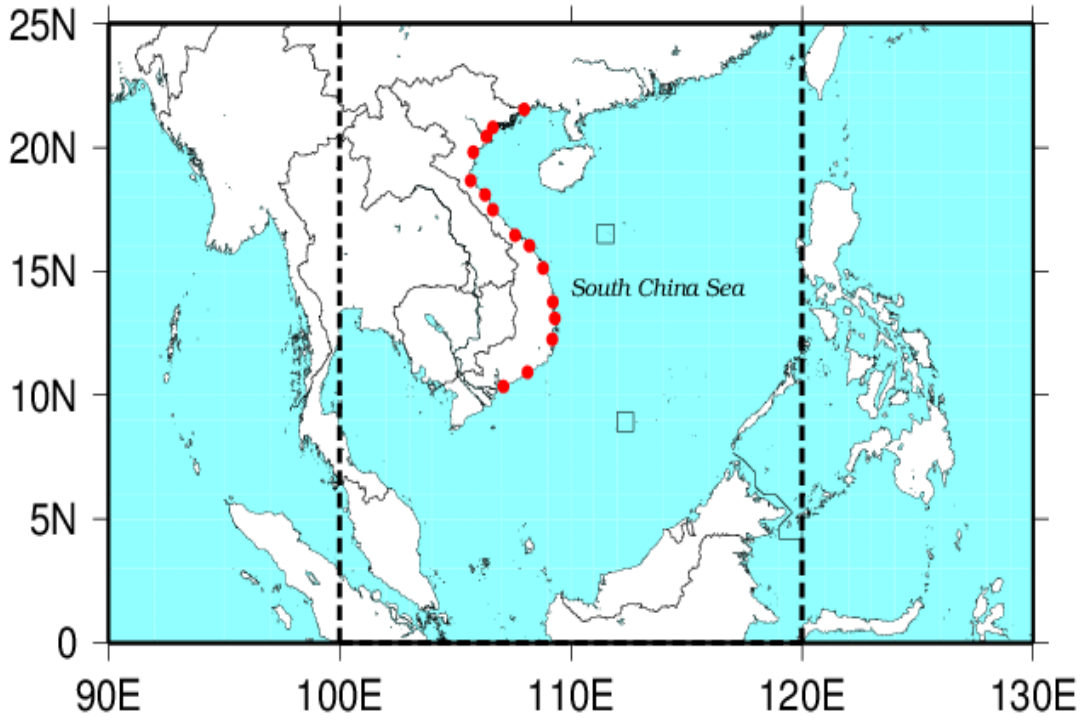


Fig. Map of 15 weather stations (red dots) and the South China Sea

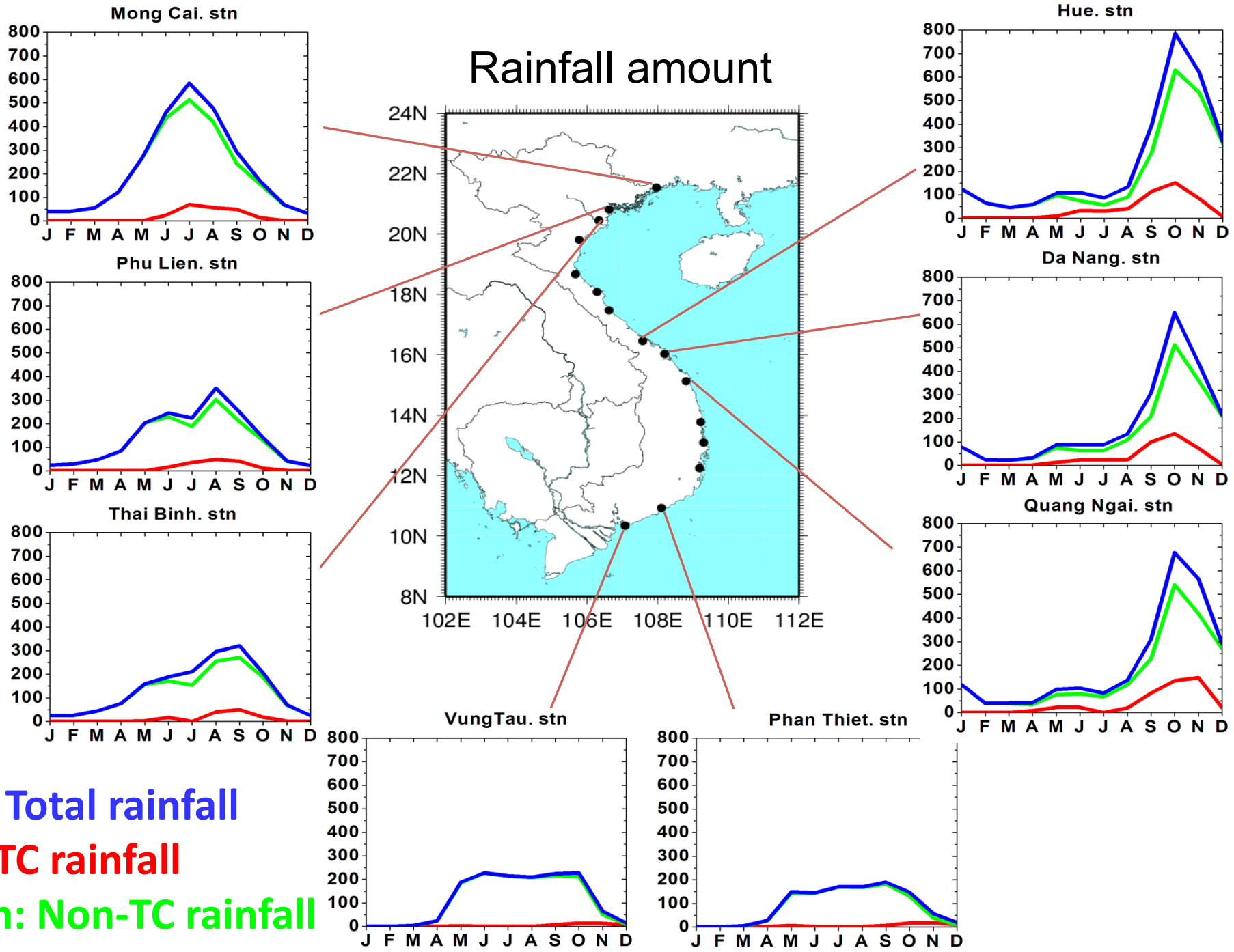
Data used and Methods (cont.)

- Englehart and Douglas (2001): 550 km from the center.
- Gleason (2006): 600 km from the center. His definition considered the 600 km distance is believed to satisfactorily account for the majority of all rainfall associated with TC.
- Kubota and Wang (2009) assumed that the influential radius is 1000km from the station to center.
- Jiang and Zipser (2010) and Hattori et al. (2010) used 500 km of the center of the TC.

Data and Methods (cont.)

- Non_TC rainfall = Total rainfall – TC rainfall.
- TC rain ratio = TC rainfall/Total rainfall.
- Heavy rainfall days caused by TC is defined as day in which the daily rainfall amount exceeded to 50mm (TC_R50).
- All factors are calculated when a TC is within 600km distance from the station.

Rainfall amount

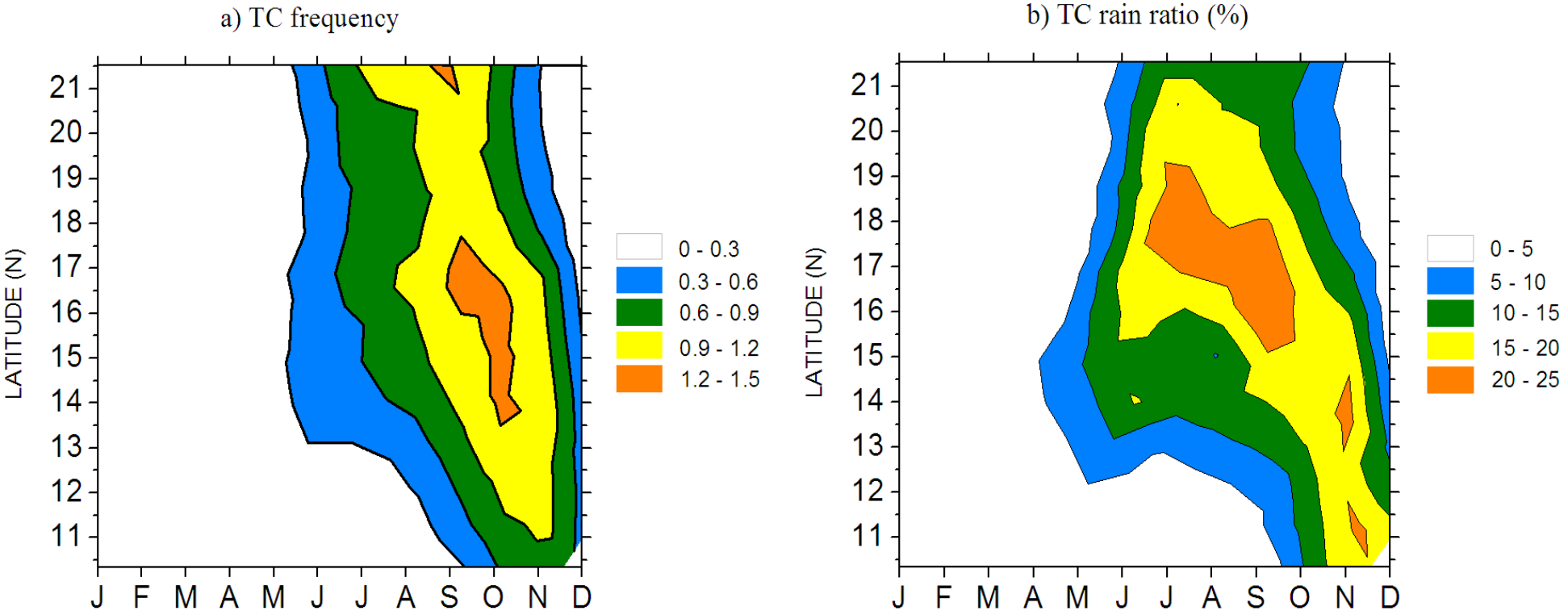


Blue: Total rainfall

Red: TC rainfall

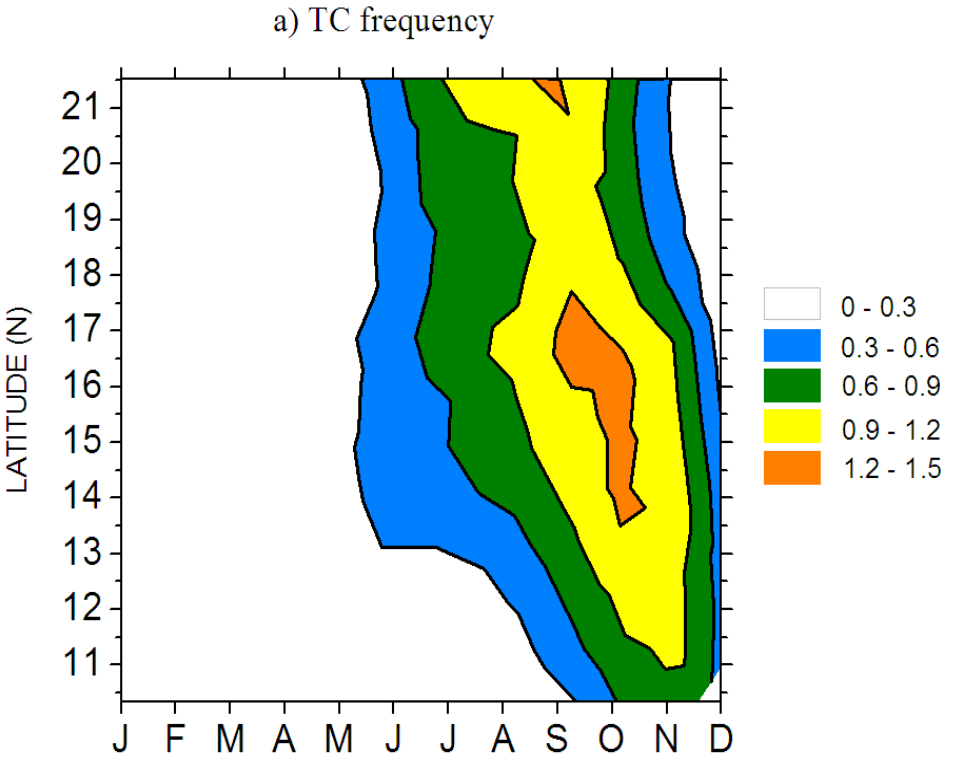
Green: Non-TC rainfall

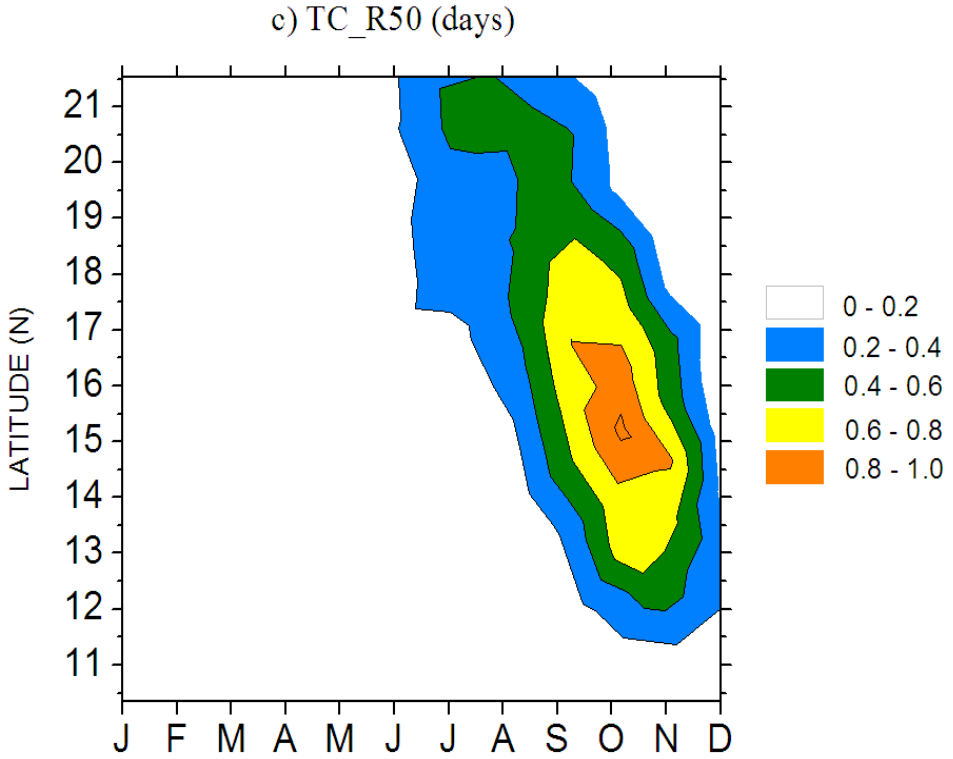
TC frequency and TC rain ratio



- TC rain ratio contributes between 0% and 25%.
- From 18°N to northward, maximum TC rain ratio shifts to July.
- Highest TC rain ratio is located in the region 16°N-18°N, up to 25% in September.

TC frequency and TC heavy rainfall days (TC_R50)

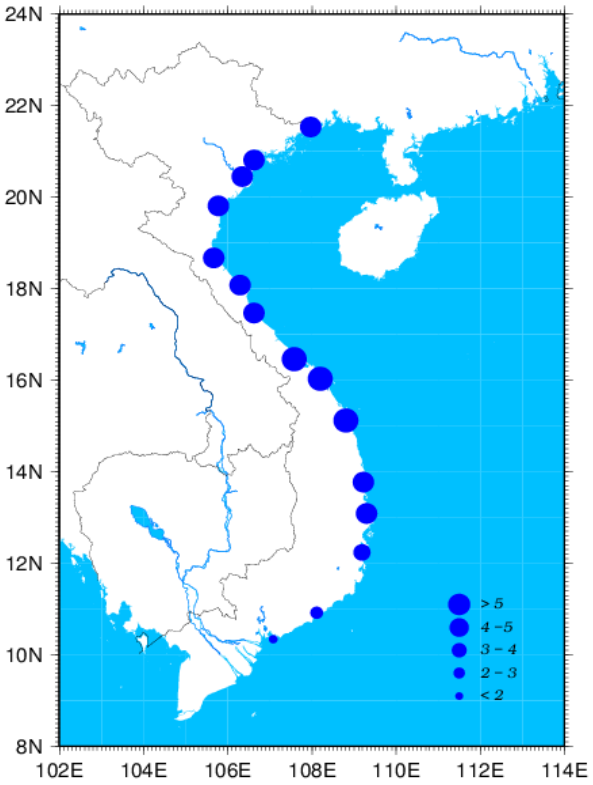




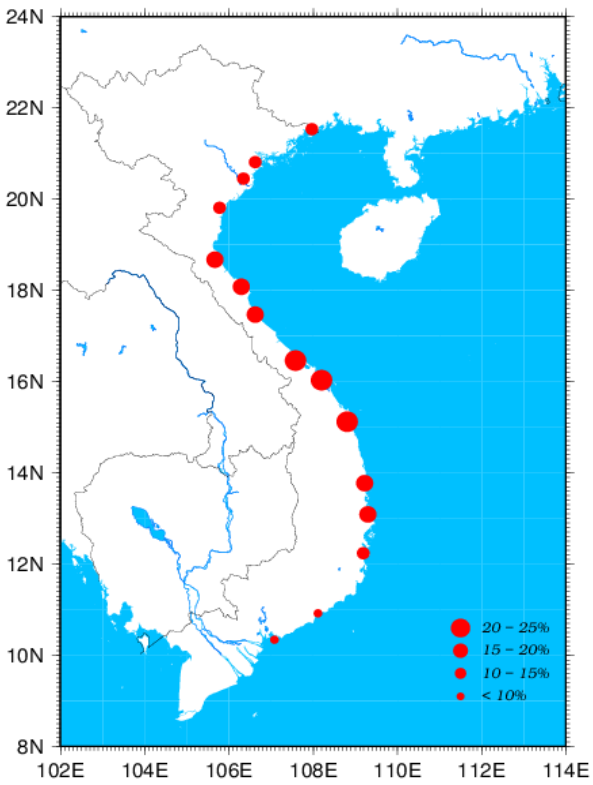
- TC_R50 starts in June and become more frequent during July-November.
- Region15^{o}-17^{o}N receives maximum TC_R50 in October and November.

Annual (June – December) distribution of TC rain ratio and heavy rainfall days

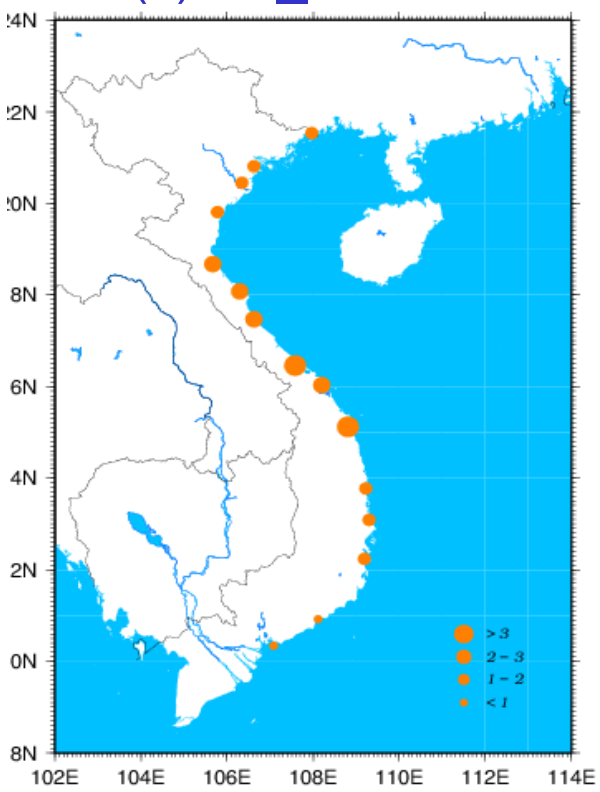
(a) TC frequency



(b) TC rain ratio



(c) TC_R50



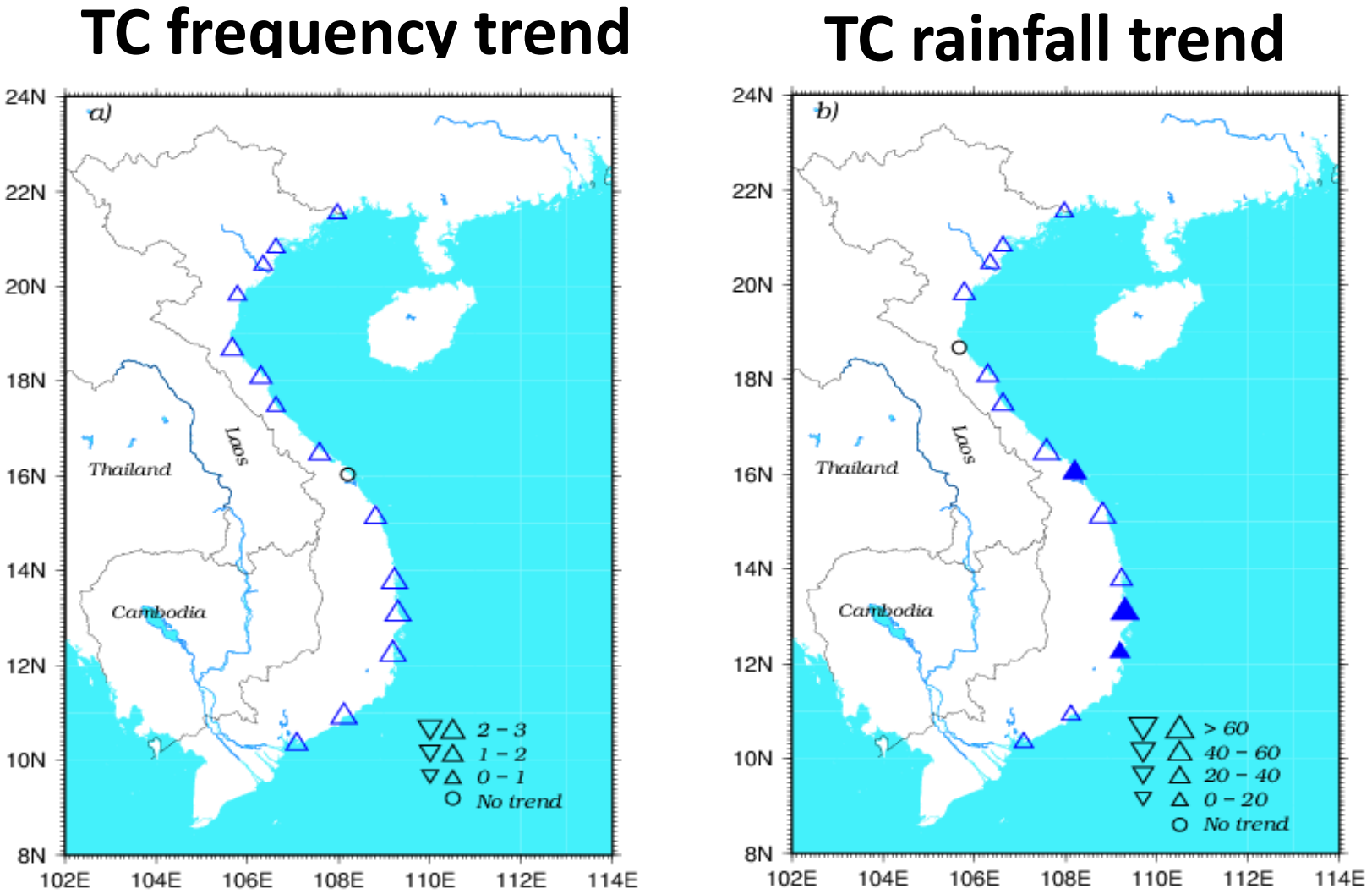


Fig. Annual trend of TC frequency (left) and TC rainfall (right). An increase trend is shown by a triangle, while a decrease trend is shown by an inverted triangle. Closed symbols indicate significant trends at the 5% level and black circles display no trend.

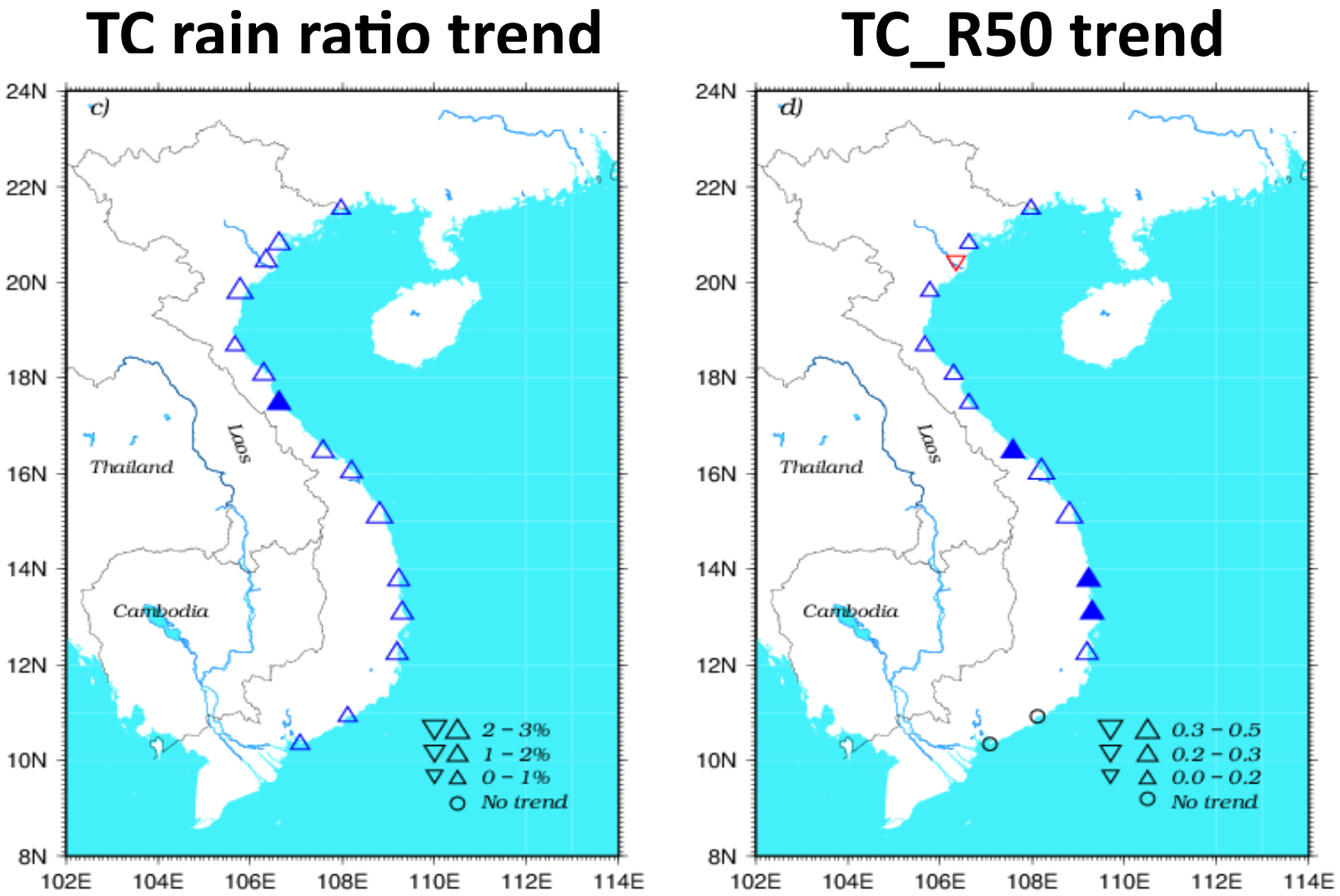


Fig. Annual trend of TC rain ratio (left) and TC_R50 (right)

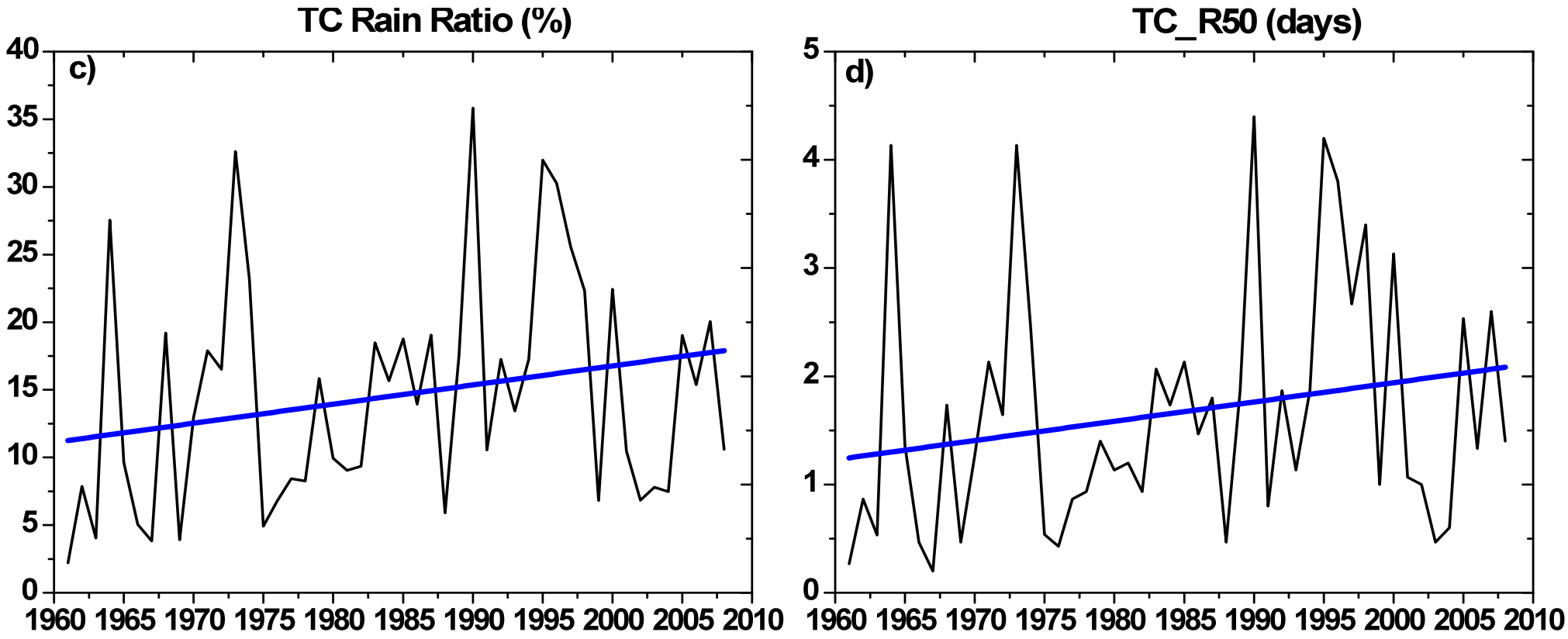


Fig. Annual (June-December) trend of TC rain ratio (left) and TC_R50 (right) (average of 15 stations)

Conclusions

- The maximum TC rainfall occurs from July to September in the northern region, whereas the total rainfall at stations south of 12°N is mainly composed of non-TC rainfall.
- The TC rainfall amount is concentrated in the central region, with a peak in October-November.
- The TC rain ratio varies from 0 to 25%, showing a maximum value in the region of 16°–18°N in September.
- The 15°–17°N region receives a maximum TC_R50 in October and also has the highest TC frequency in the same period.

Conclusions (cont.)

- TC rainfall and TC rain ratio have an increasing trend in all regions (except one station).

- A significant increasing trend is found in the central region, but no significant trend is detected in the south region.

- Annual average TC rainfall over 15 selected stations has a significant increasing trend during the 48-year period.

Thank you very much
for your attention!